Combined Pedal for Acceleration and Braking in Four Wheeler

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Abstract- *It has been reported that some automobile accidents are caused by mistakenly pressing down the accelerator, when the intention was to press down the brake. Reaction time, from onset of an accident stimulus until the brakes are initially applied, is 0.256 seconds with this one pedal system, versus 0.468 seconds under the conventional two pedal accelerator - brake system. This saving of over 45 percent in reaction time, results in the brakes of a vehicle being applied about 19 feet earlier at 60 mph. So this design makes ergonomically fit for user that enables reducing shifting time between accelerator and brake. Combination of brake and accelerator pedal is very much useful for driver.*

Keywords- Automobile accident, shifting time, misapplication of pedal pressing, Arduino, Servo motor.

I. INTRODUCTION

Nowadays the increment in the death rate of India is 20% because of the accidents on the highways hence this innovation can help us to reduce the death rate by 7% to 10% since this can be used in the any 4 wheeler. The innovation relates to the improvements in the mechanical movements and has a particular reference to a combined foot brake pedal and accelerator pedal movement. It essentially consists of a joint pedal for operating the brake and accelerator, arranged in such a form that its action to affect one or the other function is carried out without the possibility of error, and without one function interfering with the other. Pressing with the foot on the superior or upper part of the single pedal controls the charge to the vehicle motor, pressing with the foot on the lower or inferior part of the pedal controls the brakes of the vehicle. A see-saw rod contacts directly or indirectly with the ends of both the vehicle gas control rod or the brake control rod, and the motion of the pedal pressed down on its top end acting through the see-saw rod moves the charge control mechanism from neutral position to gas control position, and pressing the lower end of the pedal actuates the brake control mechanism.

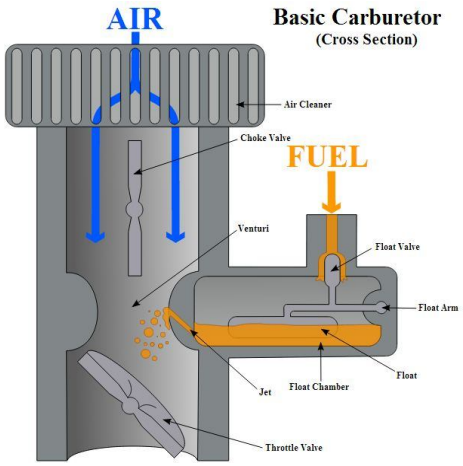
Thus, the action of the human foot with this device is very similar to that with the customary two pedal control, for the usual accelerator is usually operated by toe pressure and the brake pedal is usually operated by heel pressure.

About Acceleration& Braking:

Acceleration: The throttle pedal is a direct line to your car's engine. It controls the airflow into the intake manifold either through a throttle body for fuel injection, or a carburettor. This air is then mixed with fuel, fed either by a fuel rail and fuel injectors, or a carburettor, and is then introduced with spark (such as fire), fed by spark plugs. This causes combustion, which forces the engine's pistons down to rotate, the crankshaft. As the throttle pedal gets closer to the floor, the more air is sucked into the intake manifold to be mixed with even more fuel to rotate the crankshaft faster. This is your engine "revving" as the revolutions per minute (rpm) of the crankshaft increase. i.e.

"When you step on gas pedal and floor it, you are actually allowing more air fuel mixture to enter to the Cylinder. Generally, the pedal is connected to throttle lever. When throttle valve opens more air and fuel crosses the throttle body. More Air and fuel means more punch on the piston which gives acceleration."

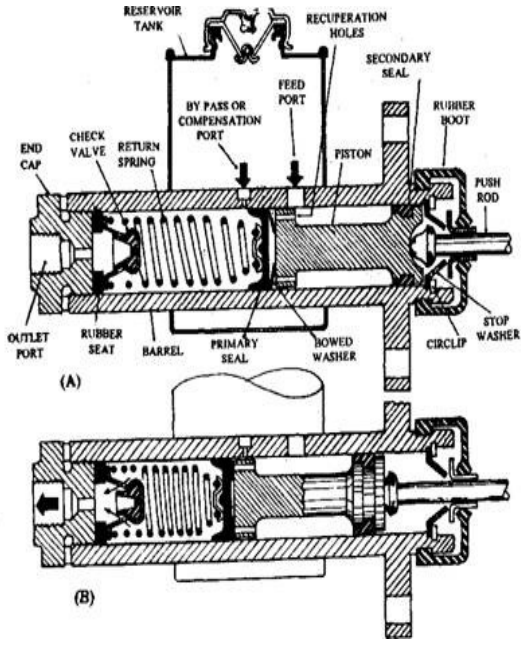
More fuel and air = more power = acceleration



THROTTLE VALVE

Braking: When the foot-pedal is applied, the push-rod pushes the master-cylinder piston along its bore. Immediately the bypass or compensation port is sealed 'off, and fluid ahead of the piston is trapped. The pressure developed in the master-cylinder pushes the lips of the check-valve cup away from the metal body so that fluid is displaced into the pipelines. This forces the calliper or shoe wheel-cylinder pistons, causing the discs or drums to be braked.

When the foot-pedal is released the master-cylinder return-spring moves the piston back against its stop washer and circlip faster than the return of fluid from the disc or drum wheel-cylinders. It therefore causes a depression in the master cylinder. The primary seal is drawn away from the piston head distorting it, thereby uncovering the recuperation holes. At the same time fluid returning from the brakes, being under load from the disc-brake piston seals or drum-brake retraction springs, pushes the whole check-valve body away from its rubber seat and so flows back into the master cylinder. The fully returned piston then uncovers the bypass on compensation port so that any excess fluid created by the expansion of the heated fluid is released to the reservoir from the pressure chamber. A typical master cylinder is as shown in figure.



BRAKE CYLINDER

II. LITERATURE REVIEW

1. Antonio Frontcra Pascual:

The subject of the present descriptive memorandum is a combined accelerator and brake pedal control system for automobiles. At the present time, as is known, automobiles are equipped with independent pedal controls for operating the accelerator and the brake.

2. Rickard Nilsson:

This study by Rickard Nilsson is focusing on adaptability of new invention by drivers because drivers actually face lot of problems in adapting new method of accelerating and braking using combined brake and accelerator pedal instead of separate pedal.

3. Charles Rabin:

The present invention generally relates to a control device for automobiles or similar type vehicles having an internal combustion engine with a carburettor normally provided with a throttle valve for controlling the inlet of a fuel and air mixture in which there is incorporated a construction providing for closing of the throttle valve when the brakes of the vehicle are applied and providing for opening of the throttle valve when the brakes are released.

4. **Sahil Arora:**

With the above study we can conclude that this new mechanism results in avoiding interference of braking during acceleration and vice versa. Moreover, it is advantageous over conventional pedals. This combined pedal mechanism thus provides a driving control which permits the quick and smooth transition from acceleration to braking, without needing to transfer the foot from one pedal to another. The rapid increase in number of vehicles on roads day by day, demands an exploration of such mechanism to get rid of driver's effort and reduce road accidents.

5. N. Ramachandran, R. Raghul:

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III. OBJECTIVES

Design and fabrication of single pedal brake accelerator mechanism to reduce pedal shifting time and to reduce the possibility of misapplication of pedal or bad hit of pedal.

The major objectives of single pedal brake-accelerator mechanism are:

1. Design of a mechanism which consist of two systems i.e. braking system and acceleration system.
2. Combining the braking pedal and accelerator pedal mechanism on single pivot.
3. Arranging the motions of two different pedals so that can be handled by same foot.
4. Motions of two pedal should not interfere with each other.
5. Working of two systems should be separate and should not interfere with each other.

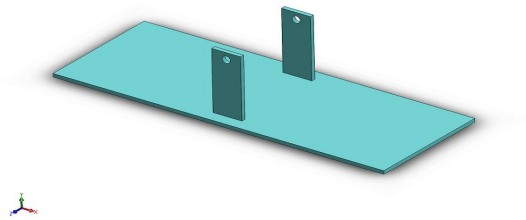
IV. COMPONENTS

Following are the main components that are assembled together in the model:

COMPONENTS OF MULTIPURPOSE PEDAL

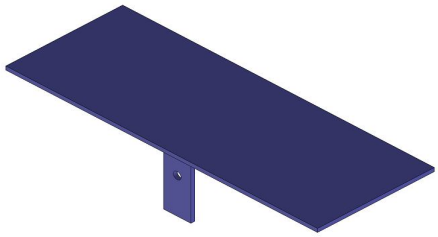
SR.NO	NAME OF THE PART	QUANTITY
1	PEDAL BASE	1
2	FOOT PEDAL	1
3	CONTACT SENSOR (POTENTIOMETER)	1
4	ARDUINO CIRCUIT	1
5	SERVOMOTOR	2
6	MASTER CYLINDER	1
7	THROTTLE BODY	1
8	SPRINGS	2

1. Pedal Base:



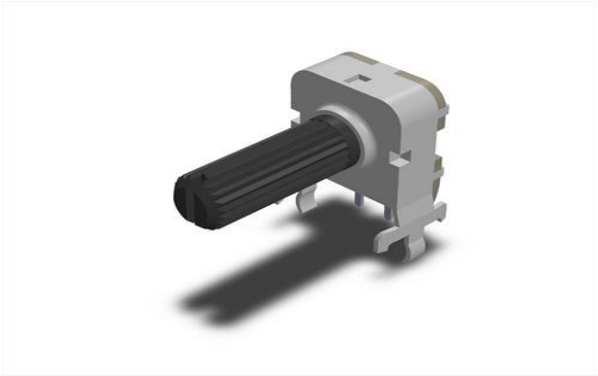
- Generally, act as a car base and support to the foot pedal system.
- The two vertical clamps are used to attach the foot pedal.
- Material: - Mild Steel

2. Foot Pedal:



- Foot pedal is the main component used to apply brakes or accelerate by applying force through the foot.
- The two vertical clamps are used to attach the pedal base.
- Material: - Mild Steel

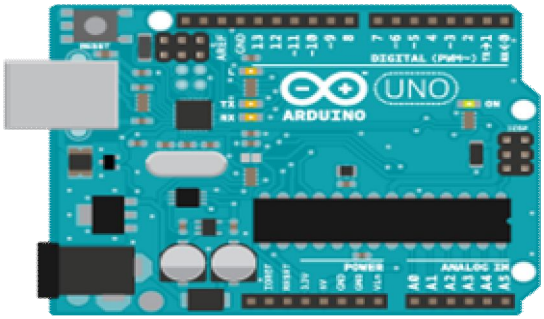
3. Contact Sensor (Potentiometer):



- The potentiometer or contact sensor is generally used to sense the angle of tilt by varying its resistance.

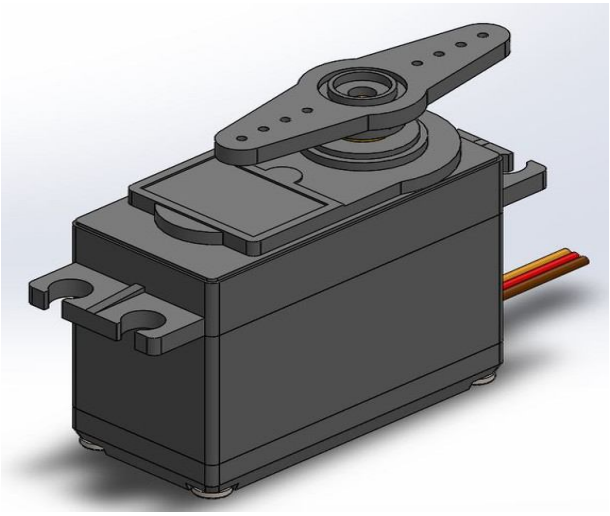
- The black knob is attached to the foot pedal and sensing its tilt, it gives input to the Arduino circuit.
- Specifications: Resistance: 0-1 kΩ over angular rotation of 300 degrees.

4. Arduino Circuit:



- Arduino circuit is a simple electronic circuit with a program installed in it.
- Input: Pedal tilt to sensor to circuit.
- Output: Circuit to Servomotor to links for acceleration or braking.
- Program: To control servomotor through potentiometer as input using Arduino.

5. Servo Motor:



- Servomotors have their applications where there is a need of high torque instead of high speed.
- Receiving the input from Arduino it sets the angle as scaled in the program. The deflection results in pull/push of the link attached at one or both of the arms.
- Specifications:

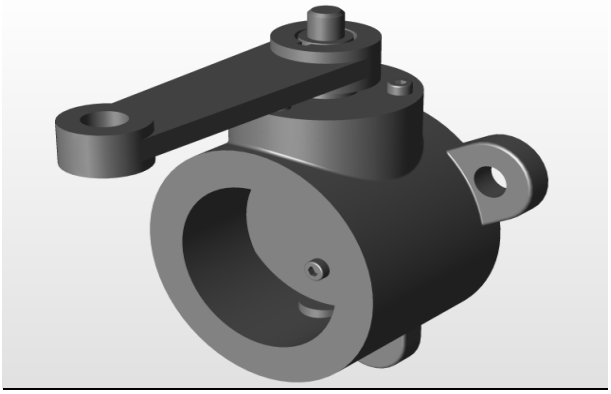
Operating Speed: 0.17sec or 60 degrees (4.8V no load). 0.13sec or 60 degrees (6.0V no load).
Stall Torque: 6 kg-cm (180.5 oz.-in) at 4.8V. 5 kg-cm (208.3 oz.-in) at 6V.
Operation Voltage: 4.8 to 7.2Volts.
Gear Type: All Metal Gears.
Bearings: Dual

6. Master Cylinder:

- Master Cylinder or Brake Cylinder is used to transfer the braking effort from the foot pedal to the brake callipers along with amplifying it.
- The push rod is connected to the link that is connected to the servomotor on another end. As the arm rotates about a certain angle, the link is pulled and using a lever the pull force can be converted into push force of the push rod.
- Specifications:

Calliper Combination: Two 81100/82100 4-Piston Callipers
Area of Piston: 9.6 sq. in
Master Cylinder Size: 7/8" Bore
Master Cylinder Stroke: 1.25" Stroke

7. Throttle Body:

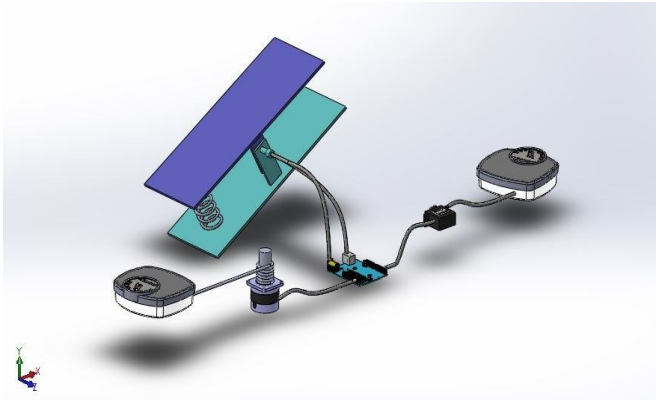


- A throttle body is used in the carburettor for mixing the mixture of air and fuel to be feed in the engine cylinder.
- It controls the amount of charge entering the inlet of the engine by creating an obstruction in between.
- The link attached to another or same servo motor is tied on the arm of throttle valve shown on the top. As the link is pulled, the arm is pulled and the valve is opened.

8. Springs:

- Spring is an elastic body, whose function is to distort when loaded and to recover its original shape when the load is removed.
- In these model, springs are used to retain the original position of the foot pedal when unloaded while accelerating or braking.
- Material: - High Carbon Steel

V. MODEL & ITS WORKING:



I. While acceleration, the driver has to apply load through his front portion or toe portion of the leg. The contact sensor also known as potentiometer attached to the pedal will sense the angle of tilt through variation in the resistance and sends an input to the Arduino circuit in the processor chip. The processor will scale the value of resistance to the angular movement of servomotor's shaft. As the shaft turns, the link attached to it comes under tension and a pull force is applied. That pull force will actuate the lever of throttle valve resulting in opening and closing of it. Hence controlling amount of charge entering the engine cylinder, the process of acceleration is carried out.

II. While braking, the driver has to apply load through his back portion or heel portion of the leg. The contact sensor attached to the pedal, again in the same way will sense the angle of tilt in another direction through variation in the resistance and sends an input to the Arduino circuit in the processor chip. The processor will again scale the value of resistance to the angular movement of another servomotor's shaft. As the shaft turns, the link attached to it comes under tension and a pull force is applied.

Here this pull force is first converted as push force by using a lever. The push force on other end of lever is applied to push rod of brake cylinder. Hence the pressure applied by the fluid in brake cylinder will force the callipers towards the brake disc plate. Hence brakes are applied and the process of braking is carried out.

VI. CONCLUSION

It is possible to merge the operations of acceleration and braking under a single pedal. It is true that getting used to a new way of driving is hard to learn for pro drivers, but for the learners this innovation will be helpful to them as it can:

1. Reduces the reaction time.
2. Avoids pressing of wrong pedal.
3. Reduces chances of accidents.

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